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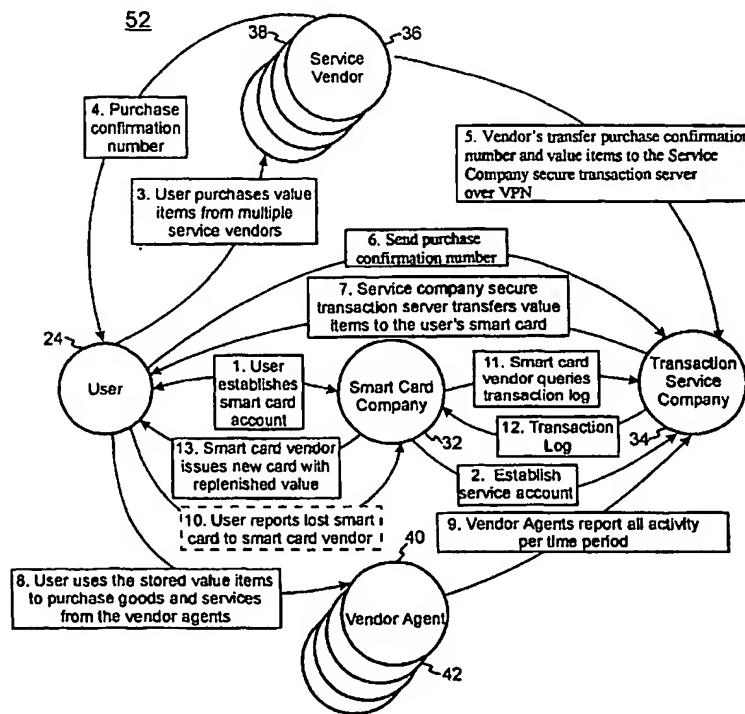
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(54) Title: STORED ELECTRONIC VALUE METHOD FOR SMART CARDS



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reported back to the transactional service company for updating the account of the user. Should the smart card be lost, the service company can identify the remaining balance in the card and have remaining value unit items loaded in a replacement card that is provided to the user.



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STORED ELECTRONIC VALUE METHOD FOR SMART CARDS**TECHNICAL FIELD OF THE INVENTION**

The present invention pertains in general to electronic stored value systems and in particular to the storing and accounting of value in such systems.

5 BACKGROUND OF THE INVENTION

Smart cards have a processor and memory incorporated into a thin plastic device that is essentially the size of a credit card. These devices have highly developed security provisions to limit access to only those parties who are authorized to have access. Smart cards store value items electronically such that the user can purchase 10 goods or services by transferring electronic value from the card to the merchant or provider who can then redeem the electronic value for cash or other value. However, the limited memory available in smart cards restricts the extent of use of these cards because each independent application used by the cards requires a separate application program which consumes much of the card memory space and limits the memory 15 available for storing the data for defining value items.

A further problem is that the loading of value items into a smart card requires a highly secure communication channel requiring specialized software and procedures. The implementation of such software and procedures poses a substantial operating cost to each of the individual vendors of goods and services using smart card distribution.

20 A still further problem with the widespread implementation of smart cards is that the possibility of loss or theft of the card poses a detriment to the use of the cards. Since the value itself is stored on the card, a user could suffer a loss much like that of having cash stolen or destroyed. A primary advantage of credit cards is that the liability of the user can be limited so the user is encouraged to widely employ the card 25 for almost any kind of goods or services. Thus, there exists a need for a process to make possible the replacement of value in a lost or stolen smart card.

SUMMARY OF THE INVENTION

A selected aspect of the present invention for use of smart cards is the organization, programs and data in the smart card memory as well as application programs for the smart card. The memory structure in the smart card has a single application program for storing and accessing a plurality of value units that are stored in the memory of the card. A data field comprises a plurality of groups of value units with each group corresponding to a different vendor for the value units. Each group of value units has an identification character for defining the vendor associated with the group. A further aspect is that each of the vendor agents which receive the value items in return for goods and services utilizes a common algorithm in the application program for reading and operating the smart card, thereby making possible use of the smart card by an unlimited number of unassociated providers.

A further aspect of the present invention is directed to the loading of value items into a smart card. A plurality of vendors sell value items to users and these value items are transmitted to a common secure server. This server establishes a secure communication channel to a processor which has the smart card connected thereto. The server then transmits the value items via the secured channel for loading into the smart card.

A still further aspect of the present invention pertains to the replacement of lost or stolen smart cards. A smart card is loaded with a predetermined set of value items and a record of these value items is loaded into a secure server. The smart card is used at a venue and one or more of the value items is removed. A report of the value items removed is transmitted to the secure server. Upon receiving a request for a replacement card, a determination is made for the value items which have not been reported removed from the smart card by use of the record of the items previously loaded and the list of removed items reported to the secure server. A replacement set of value items is then stored in a replacement smart card that is provided to the user.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings in which:

5 Fig. 1 is a schematic illustration of a network for utilization of the present invention showing a user, service vendors, a smart card vendor, a transaction services company and multiple venues for use of the smart card,

Fig. 2 is a state diagram illustrating the dataflow and functions performed with respect to each of the entities shown in Figure 1,

10 Fig. 3 is a memory structure for a prior art smart card,

Fig. 4 is a memory structure for a smart card as utilized in accordance with the present invention, and

Fig. 5 is a schematic illustration of the application programs involved in the use of smart cards in accordance with the present invention.

15 DETAILED DESCRIPTION

A "smart card" is a product having essentially the dimensions of a credit card but having fixed within the body of the card electronic circuitry generally including a microprocessor and memory. A representative embodiment of a smart card is described in U.S. Patent No. 6,050,494 entitled "Smart Card", which is incorporated herein by reference.

A principle existing application for a smart card is to serve as a portable money transference device. A smart card is provided with very powerful security features to ensure that access to the device is limited only to those parties who are authorized to have such access. Monetary value is stored in a smart card in a secure fashion such that 25 the card can be presented to a merchant and the merchant can withdraw value from the card for the purchase of goods or services. The merchant can then electronically process the funds received to transfer them into its own account. The value stored on the card is reduced by the amount withdrawn by the merchant. The user of the smart card can return to a terminal connected to his bank and connect the smart card to the 30 terminal and command that additional value be transferred into the card from his

account. Since the smart card must be extremely small, and in particular, thin, there is only a limited amount of storage space on the card. The storage must be non-volatile because smart cards typically do not include a battery, but only obtain power when connected to a device for conducting a transaction.

5 A network 20 configuration for utilization of a smart card in accordance with the present invention is shown in Figure 1. The network 20 includes Internet 22 which provides communication between the various entities. A user 24 has a conventional personal computer 26 that is connected to the Internet 22. The user 24 is provided with a smart card 28 that can be inserted into a card reader 30 that is connected to the

10 computer 26. A smart card company 32 issues the card 28 and provides services with respect to this card. A transaction service company 34 is connected to the Internet 22 and provides services for use of the smart card 28. A service vendor 36 supplies value items that can be purchased by the user 24 and stored in the smart card 28. A service vendor 38 also provides value items for the smart card 28. The value items supplied by

15 the service vendorss 36 and 38 can be converted to goods or services by vendor agents 40 and 42, which have respective card readers 44 and 46 that are also connected to the Internet 22. The readers 44 and 46 include processors for interacting with the smart cards and communicating through the Internet 22.

20 The present invention is now described generally in reference to Figure 1, but is described in more detail below in reference to Figures 2-5. The user 24 establishes an account with the smart card company 32, who then physically transfers the smart card 28 to the user 24. The company 32 also provides the user 24 with the card reader 30, which is connected to the computer 26 and operates by use of software provided by the company 32. The smart card company 32 establishes a service account for the user 24 at the transaction service company 34.

25 The user selects a service vendor, such as 36 and makes a connection between his computer 26 with the service vendor 36 through the Internet 22. The user selects certain value items such as a ticket, gift certificate, or other electronically storable value item from the service vendor 36. Payment can be made through a conventional credit

30 card payment or other means. The vendor sends a purchase confirmation number to the user. User 24 then logs onto the transaction service company 34 where an account has

been previously established. The user 24 establishes a secure communication channel with the transaction service company. The user sends to the transaction service company 34 the purchase confirmation number which was provided by the service vendor 36. The service vendor 36 sends the purchase confirmation number and the 5 value items purchased by the user 24 to the transaction service company 34. The transaction service company 34 transfers these value items through the secure connection channel to the user computer 26 where the software within this computer loads the value items through the card reader 30 to the smart card 28.

An inventory of the value items for the user 24 is also maintained at the 10 transaction service company 34. The user 24 can purchase value items from other vendors, such as 38, and these items are similarly transferred to the transaction service company 24 in a similar process for downloading to the smart card 28.

When the user 24 desires to use a value item stored on the card 28, he must physically take the card 28 to a vendor agent 40 where it is inserted into the card reader 15 44. The user enters a PIN number at the reader 44 and the value items for the vendor agent 40 are transferred from the card 28 to the vendor agent 40. This could, for example, be two tickets for admission to a concert. The vendor agent 40 then reports back at a maximum time period, such as 24 or 48 hours, to the transaction service company 34 providing information that specific tickets have been redeemed by the user 20 24. The service company 34 then updates the user 24 account to remove these tickets from the inventory for the user 24.

Should the user 24 lose the smart card 28, he can apply to the smart card company 32 for replacement. The smart card company 32 determines from the transaction service company 34 the content that is not been consumed for the account 25 of the user 24. Smart card company 32 can then either load a replacement content in a new smart card and ship it to the user 24 or can send a replacement value items to the transaction service company 34 to be loaded into the smart card 28, as done previously.

A state diagram 58 is shown in Figure 2 for representing a detailed embodiment of the processes of the present invention. The entities illustrated are the same as shown 30 in Figure 1. The processes shown in sequential steps are as follows:

1. User establishes smart card account – The user 24 can establish an account with the company 32 on-line, through mail or other means, but in each case must provide identification as well as set up an account with the company 32. In some cases, the smart card is also used for billing, and may comprise a credit card. After the 5 account is established, the company 32 sends the smart card 28 to the user 24 together with the reader 30 and appropriate software for use with the user's computer system 26.
2. Establish service account – After the user 24 establishes an account with the smart card company 32, the company 32 sets up a user 24 account with the transaction service company.
- 10 3. User purchases value items from multiple service vendors – The user 24 can log onto a vendor web site such as service vendor 36 for the purchase of value items such as concert tickets, travel tickets, coupons, etc. Through the on-line connection the user 24 can select the particular value items desired and make payment through a conventional credit card purchase or through a secured payment connection.
- 15 4. Purchase confirmation number – Upon completion of a purchase by a user 24, the service vendor 36 transfers a purchase confirmation number for the order to the user 24.
- 20 5. Vendor's transfer purchase confirmation number and value items to the service company secure transaction server over VPN – The vendor 36 transfers the purchase confirmation number and the value items purchased by the user 24 to the secure transaction server of the transaction to the service company 34 via a VPM (virtual private network). In the present example, the value items comprise tickets to a concert that were purchased by the user 24 from the service vendor 36.
- 25 6. Send purchase confirmation number – To complete the payment process and obtain the value items purchased, the user 24 establishes a secure communication channel with the service company 34 and sends the purchase confirmation number to the service company 34.
- 30 7. Service company secure transaction server transfers value items to the user's smart card – Through a secure transaction channel, the transaction service company 34 transmits the value items (concert tickets) electronically to the computer 26 of the user 24 wherein the multiple value items are entered by a reader 30 into the smart card 28.

8. User uses the stored value items to purchase goods and services from the vendor agents – The user then physically transports the smart card 28 to the vendor agent 40. The smart card 28 is inserted into the reader 44 and the user 24 enters a PIN for verification. The terminal finds the two tickets for the concert at this time and 5 verifies the digital signatures and validity of the tickets. The tickets are electronically removed from the smart card 28 and the consumer is granted entry to the concert.

9. Vendor agents report all activity per time period – At some time, but no later than a predetermined time, after the smart card is read and the tickets are unloaded, the ticket redemption transaction is transmitted from the vendor agent 40 to the transaction 10 service company 34 for account reconciliation. The maximum time allowed could be 24 hours from the time of the event.

10. User reports lost smart card to smart card vendor – Should the smart card 28 be lost or stolen from the user 24, the user can report this loss to the smart card company 32 for receiving a replacement. This is an important service for consumers 15 because the smart card itself carries the value. Should replacement not be available, consumers would be substantially deterred from using the smart card.

11. Card vendor queries transaction log – The smart card vendor makes a query to the transaction service company 34 for the transaction log of the user 24.

12. Transaction log – The transaction service company 34 reads the account for 20 user 24 and produces a transaction log that indicates the value items that have not been reported as used. This list is transmitted to the smart card company 32.

13. Smart card vendor issues new card with replenished value – The smart card vendor loads replenished value into a new smart card based on the received list of value items and mails this card to the user 24 for subsequent use. The replacement value will 25 be the value items originally purchased from the service vendor 36 less the value items that were removed by vendor agent 40. The smart card company 32 will not load the replacement smart card until the time period for reporting the consumed items has elapsed. Optionally, the smart card company 32 can request that the transaction service company 34 load the replacement smart card through the user computer 26 in the 30 method described above in step 7.

The smart cards have limited storage capability because of the required small physical size. Contemporary smart cards have a capacity of 16k bytes which will soon become 32k bytes. However, in any case this is a limited amount of storage space compared to space used by typical application programs and data storage in computer systems. The layout of application programs in a conventional smart memory card is shown in Figure 3. Each vendor utilizes a separate application for the value items associated with that vendor. For example, if the service vendor 36, shown in Figures 1 and 2, is a seller of concert tickets, it would require the development and installation of an application for loading and using those value items that it sells for the smart card.

10 Likewise, the vendor agents that accept the value items from service vendor 36 would have corresponding proprietary software for interfacing with the application of this particular vendor.

As shown in Figure 3, the memory 70 used in a conventional smart card has 6 different application programs representing vendors of 6 different products. The 15 applications with their corresponding value item data are programs 72, 74, 76, 78, 80 and 82. Each of the application programs A-F consumes a substantial portion of the memory, but is necessary for processing the value items associated with that application. As can be seen in Figure 3, the multiple application programs create a substantial overhead that reduces the space available to the value item data entries.

20 Referring now to Figure 4, there is shown the memory organization and application program configuration for the present invention. The memory 90 includes a single universal loading/using application 92. This is used in common by all vendors. Further, only one common algorithm is used in the application program that is required by each of the vendor agents to read and interact with the application program 92 in the 25 memory 90. The value item data units are stored in the memory in association with each of the vendors by use of an identification number corresponding to the vendor. The data set 94 corresponds to a vendor identified by the number "1." Likewise, the value item data sets 96-112 corresponds to respective vendors 2, 3, 4, 5, 6, 7, 8, 9 and 10. Thus, the memory 90 configuration of the present invention utilizes a much smaller 30 proportion of the memories for the application program, thereby leaving a much larger portion of the limited memory space available to value item data units.

A further description of the present invention is in reference to Figure 5 which shows the relationships of the application program software involved in the storing and use of value items through a smart card, as previously described. The entities shown in Figure 5 include a user 130, a reader application A1 program 132, transaction service 5 company 134 having an application A program 136, a group of smart cards 138, 142 and 146 having respective application A2 programs 140, 144 and 148. There are further included a vendor agent 156 having a reader application A 3 program 158 and a vendor agent 160 having a reader application A 3 program 162.

The application programs A, A1, A2 and A3 are integrated to provide support 10 for multiple vendors through one transaction service company 134. Each of the smart cards 138, 142 and 146 has a similar application program, which represents the program 92 shown in Figure 4, for interacting with the reader application A1 as well as the reader application A3 at each vendor agent.

Although several embodiments of the invention have been illustrated in the 15 accompanying drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention.

WHAT IS CLAIMED IS:

1. A memory structure for a smart card having an electronic memory and associated processor for storing electronic value units, comprising,
 - a single application program for storing and accessing a plurality of value units stored in said memory,
 - 5 a data field comprising a plurality of groups of said value units, each group corresponding to a different vendor of said value units, and each said group of value units having an identification character for defining the vendor associated with the group.
2. A method for storing value items in a smart card, comprising the steps of: receiving value items at a secure server from each of a plurality of vendors which have sold the value items to a user,
 - 5 establishing a secure communication channel between said server and a processor which has said smart card connected thereto, and transmitting said value items to said processor for loading into said smart card.
3. A method for use of a smart card, comprising the steps of: establishing a secure channel from a server having value items stored therein to a processor having said smart card connected thereto, said value items provided by at least one vendor,
 - 5 transmitting said value items to said processor for loading into said smart card, applying said smart card at a first vendor agent, wherein said smart card is connected to a processor having a selected application program therein for reading said smart card to remove certain of said value items therefrom, and applying said smart card at a second vendor agent, which is unrelated to said first
 - 10 vendor agent, wherein said smart card is connected to a processor having said selected application program therein for reading said smart card to remove certain other of said value items therefrom.

4. A method for replacement of a smart card, comprising the steps of:
loading a first smart card with a predetermined set of value items,
storing a record of the value items loaded into said first smart card at a secure server,
removing one or more of said value items from said first smart card,
5 reporting to said secure server a list of the ones of said value items removed from said first smart card,
determining said value items not reported removed from said first smart card by reference to said record and use of said list of removed value items to produce a replacement list of value items, and
10 storing value items corresponding to said replacement list in a second smart card.

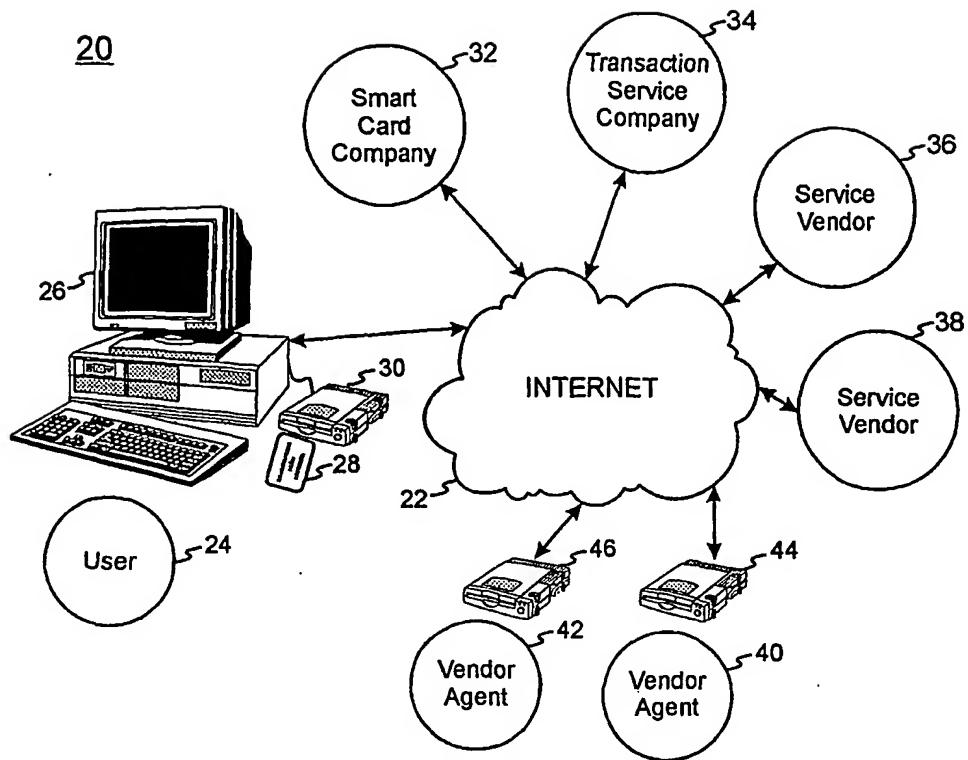


Fig. 1

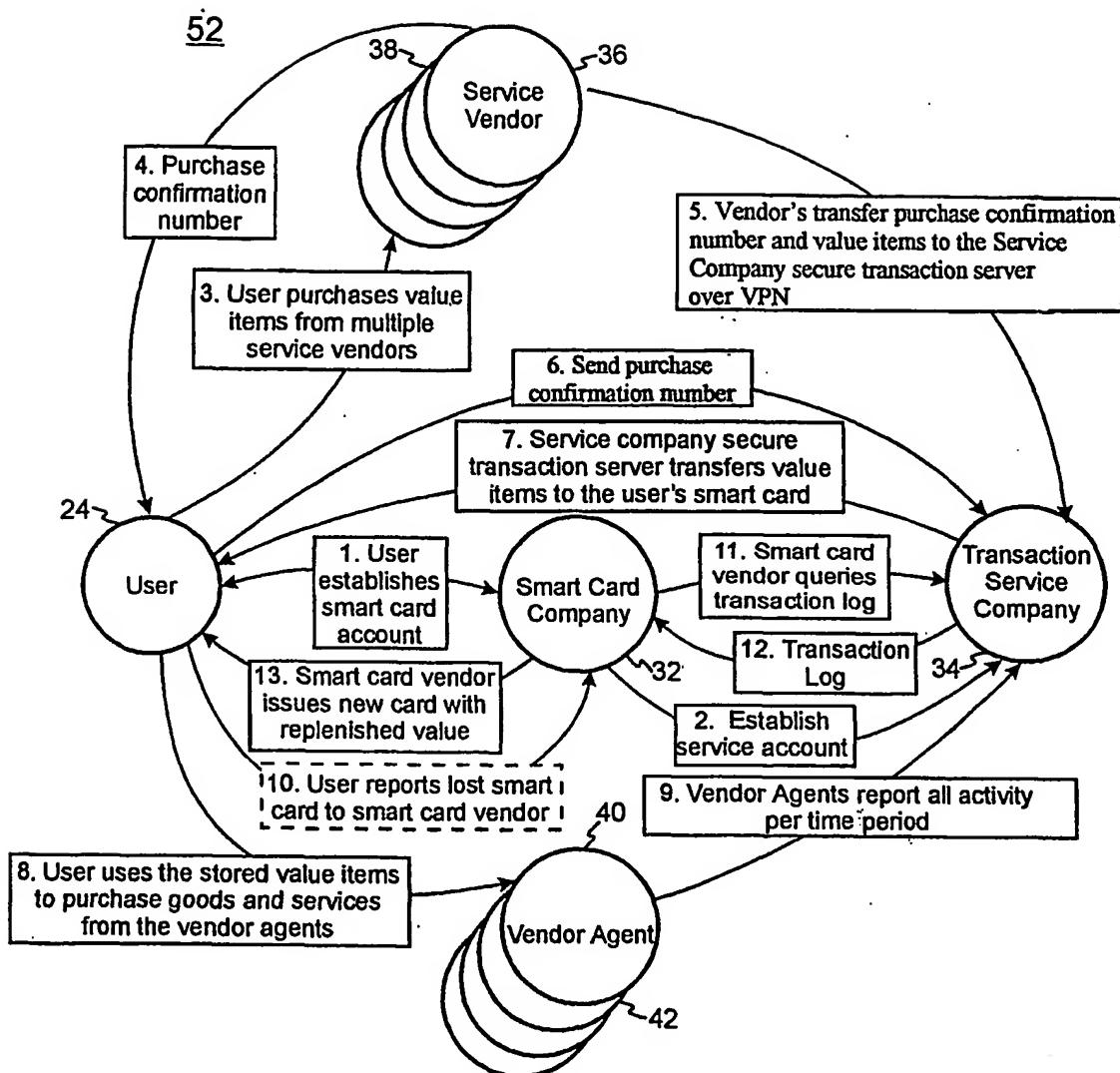


Fig. 2

MEMORY		70
LOADING/USING	APPLICATION A	
1. Value Item Data		72
2. Value Item Data		
3. Value Item Data		
4. Value Item Data		
LOADING/USING	APPLICATION B	
1. Value Item Data		74
2. Value Item Data		
3. Value Item Data		
LOADING/USING	APPLICATION C	
1. Value Item Data		76
LOADING/USING	APPLICATION D	
1. Value Item Data		78
2. Value Item Data		
3. Value Item Data		
4. Value Item Data		
LOADING/USING	APPLICATION E	
1. Value Item Data		80
2. Value Item Data		
LOADING/USING	APPLICATION F	
1. Value Item Data		82
2. Value Item Data		
3. Value Item Data		
4. Value Item Data		

(Prior Art)

Fig. 3

MEMORY		90
UNIVERSAL	LOADING/USING	
APPLICATION		92
1. Value Item Data		94
2. Value Item Data		
3. Value Item Data		
4. Value Item Data		
1. Value Item Data		96
2. Value Item Data		
3. Value Item Data		
3. 1. Value Item Data		98
1. Value Item Data		
2. Value Item Data		
3. Value Item Data		100
4. Value Item Data		
5. 1. Value Item Data		102
2. Value Item Data		
6. 1. Value Item Data		104
2. Value Item Data		
3. Value Item Data		
4. Value Item Data		
7. 1. Value Item Data		106
2. Value Item Data		
3. Value Item Data		
4. Value item Data		
5. Value Item Data		
6. Value Item Data		
7. Value Item Data		
8. 1. Value Item Data		108
2. Value Item Data		
3. Value Item Data		
4. Value Item Data		
5. Value Item Data		
9. 1. Value Item Data		110
2. Value Item Data		
3. Value Item Data		
4. Value Item Data		
5. Value Item Data		
6. Value Item Data		
10. 1. Value Item Data		112
2. Value Item Data		
3. Value Item Data		
4. Value Item Data		

Fig. 4

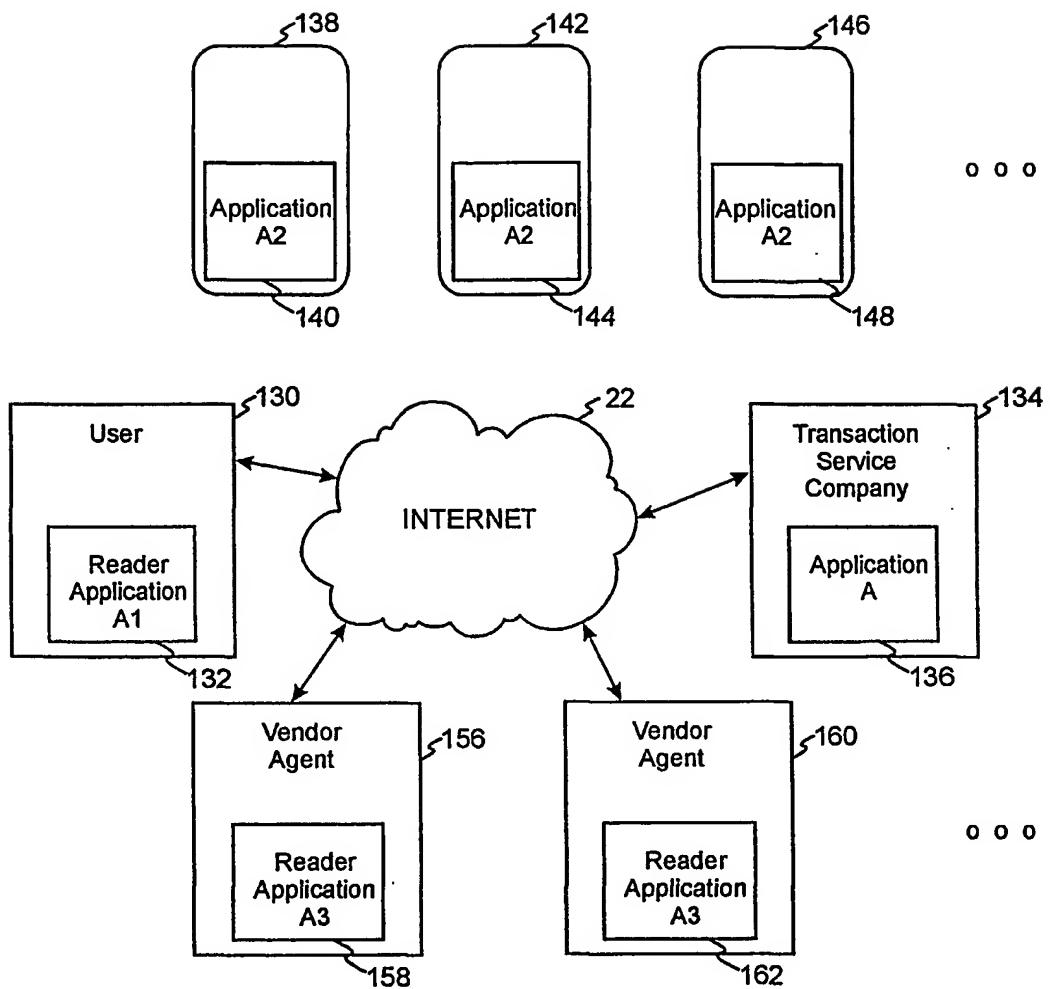


Fig. 5

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